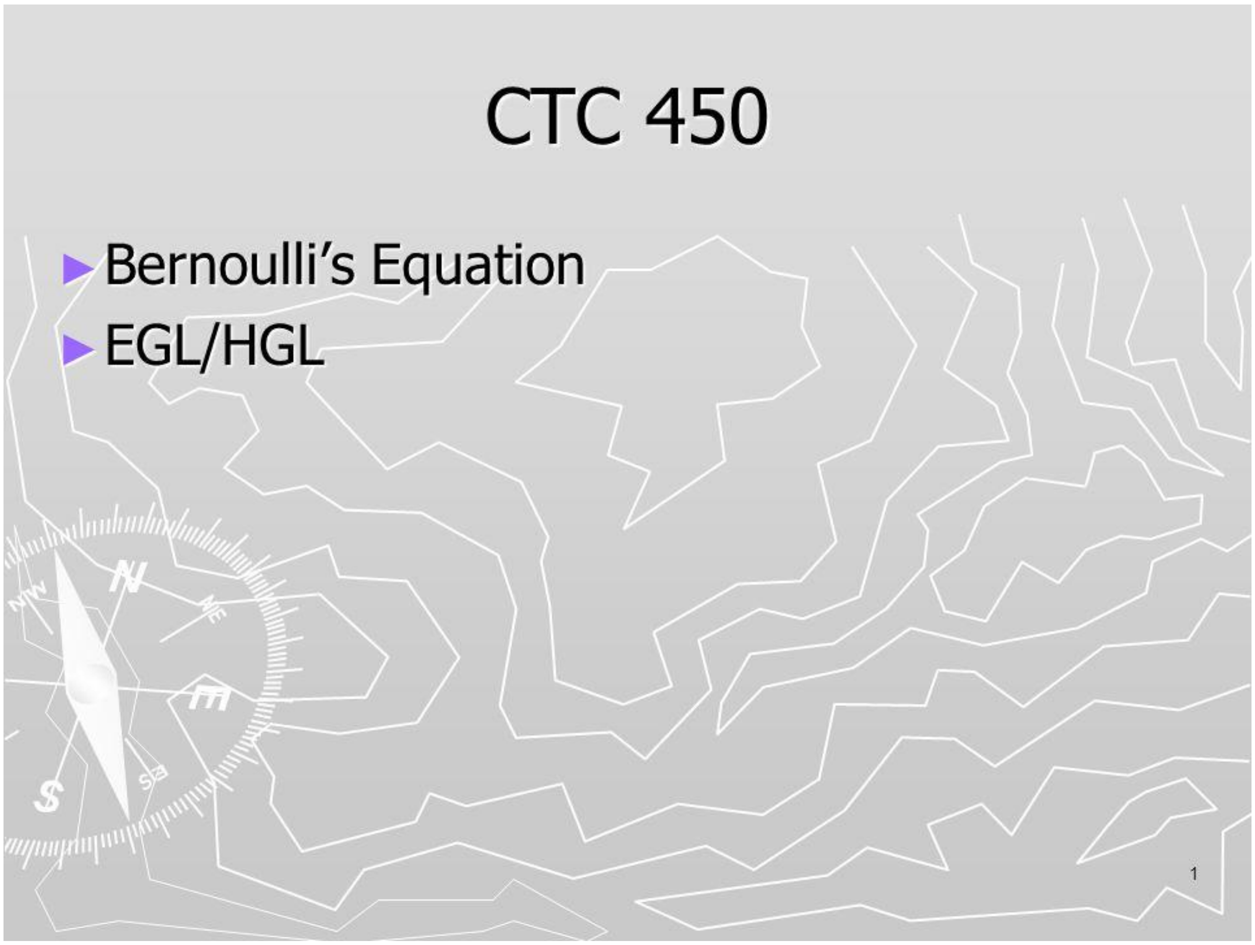
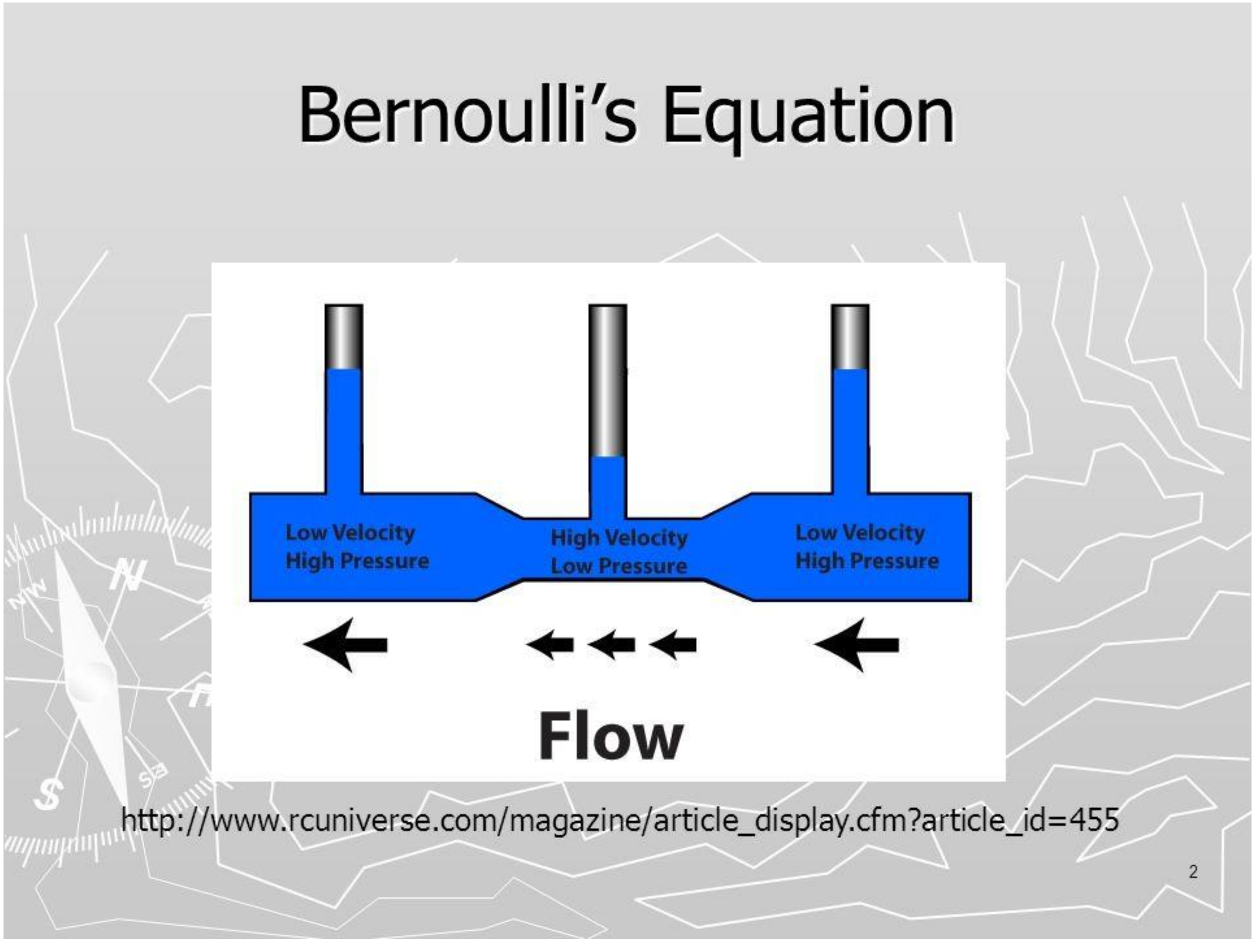
CTC 450 Bernoulli's Equation EGL/HGL.

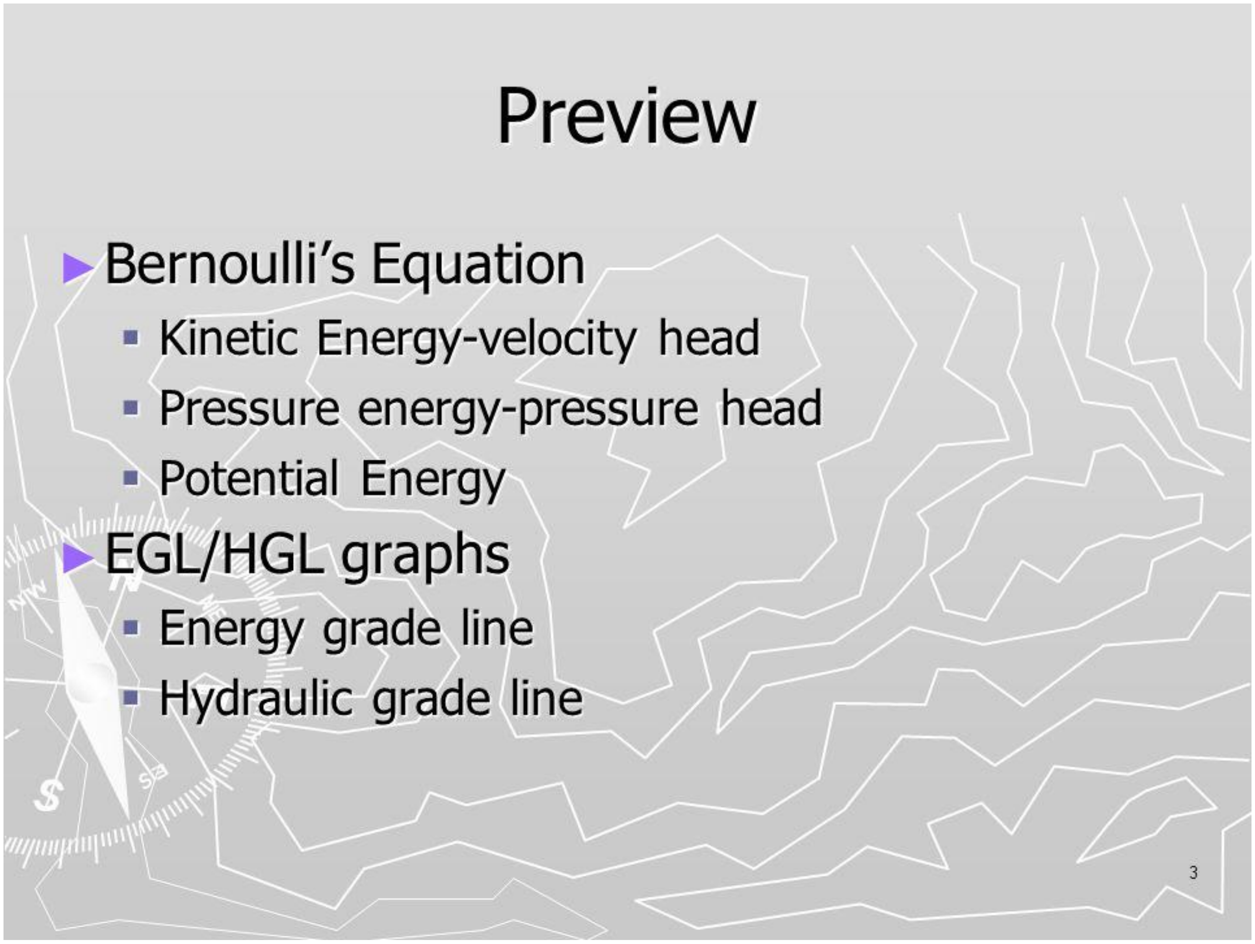
1. **CTC 450 Bernoulli's Equation EGL/HGL**



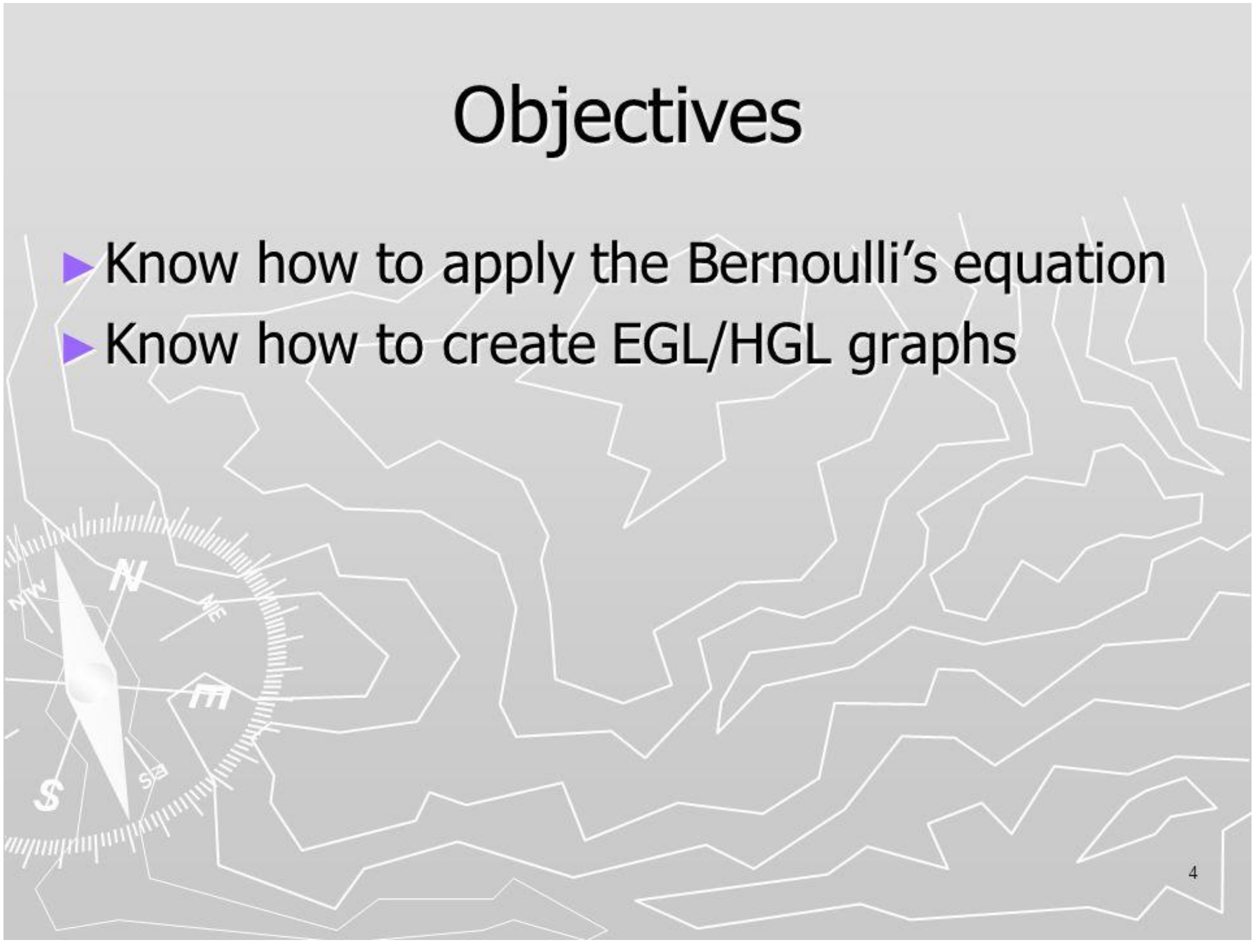
2. **Bernoulli's Equation**



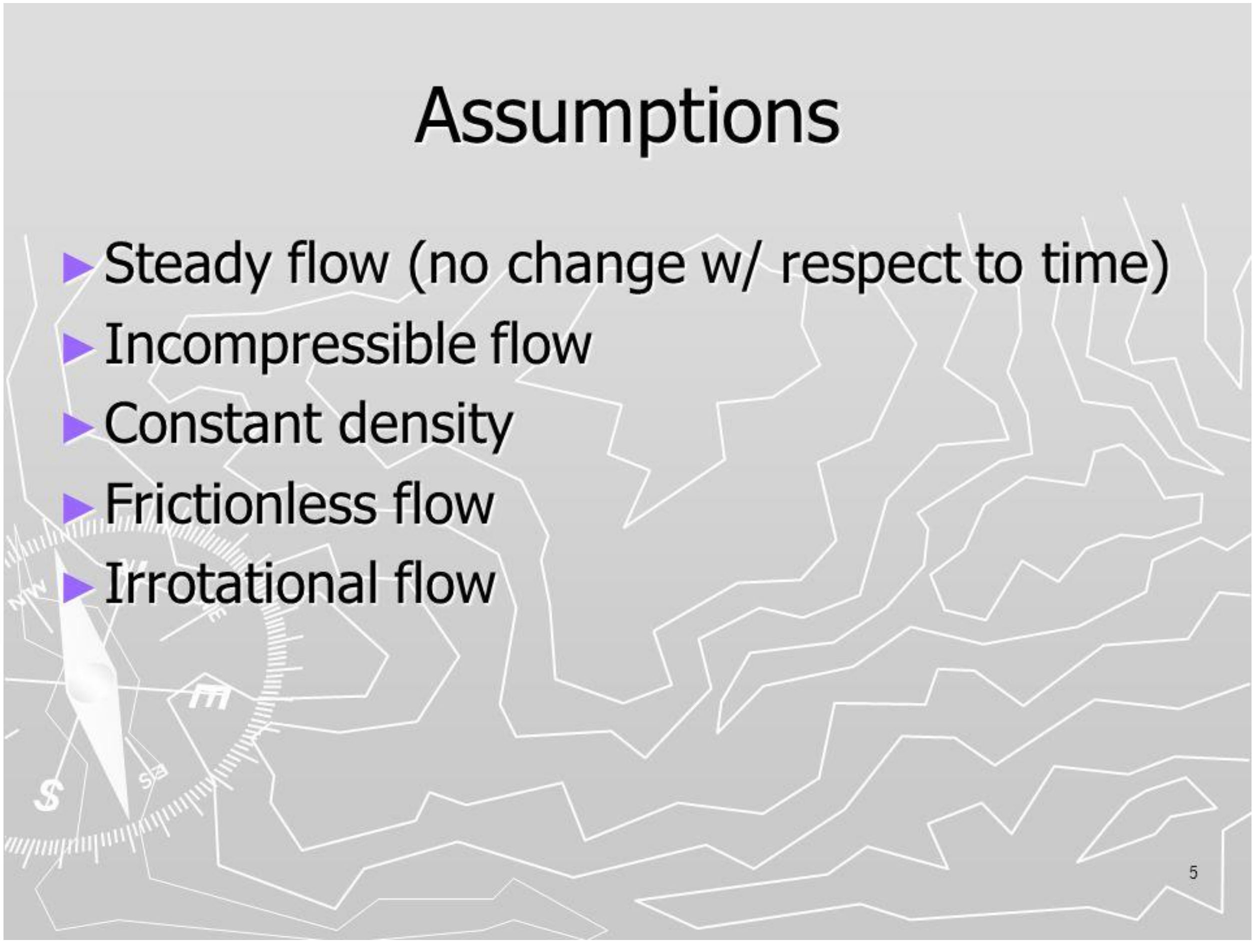
3. **Preview Bernoulli's Equation EGL/HGL graphs**
Kinetic Energy-velocity head Pressure energy-pressure head Potential Energy EGL/HGL graphs Energy grade line Hydraulic grade line



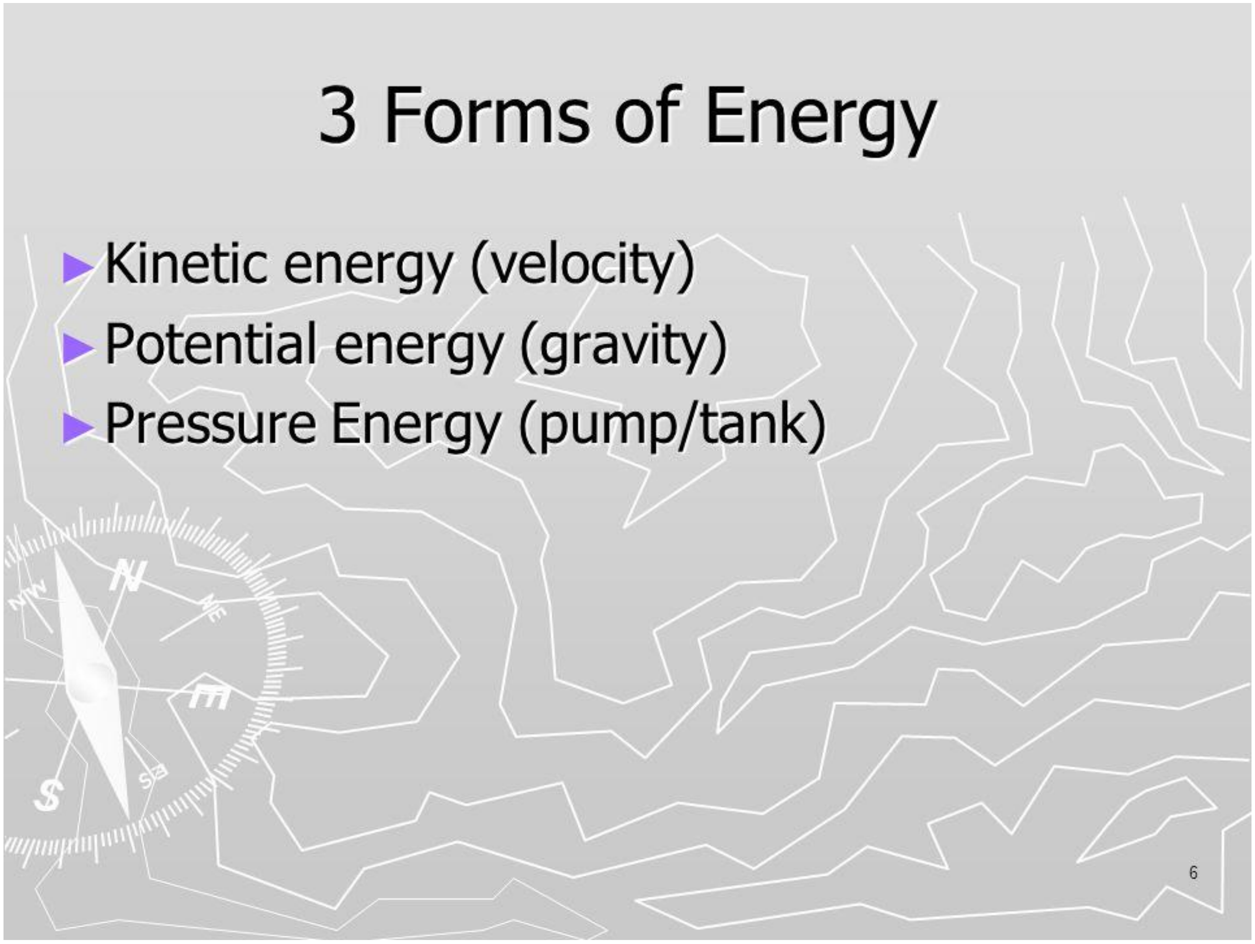
4. **Objectives Know how to apply the Bernoulli's equation**
Know how to create EGL/HGL graphs



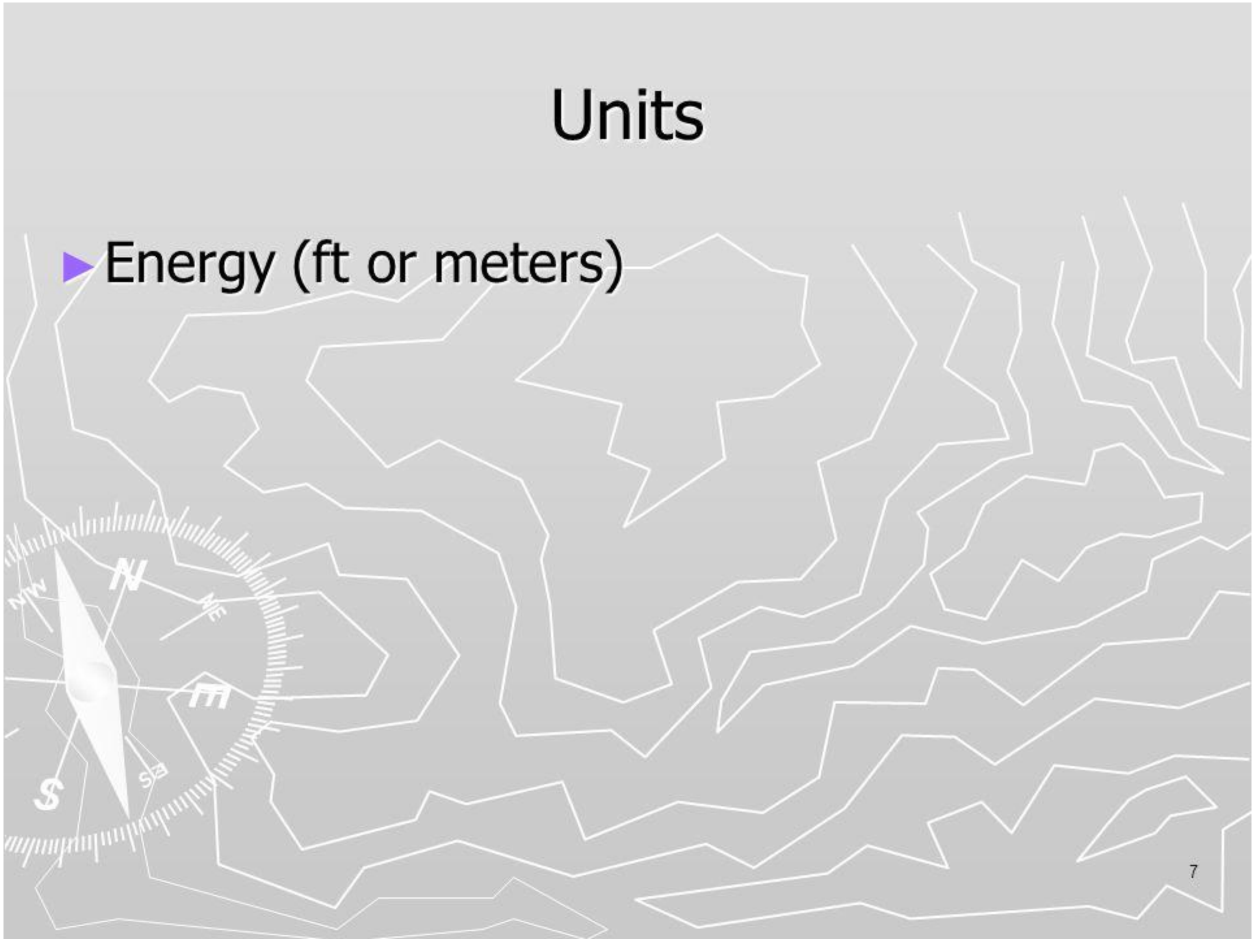
5. **Assumptions Steady flow (no change w/ respect to time)**
Incompressible flow Constant density Frictionless flow Irrotational flow



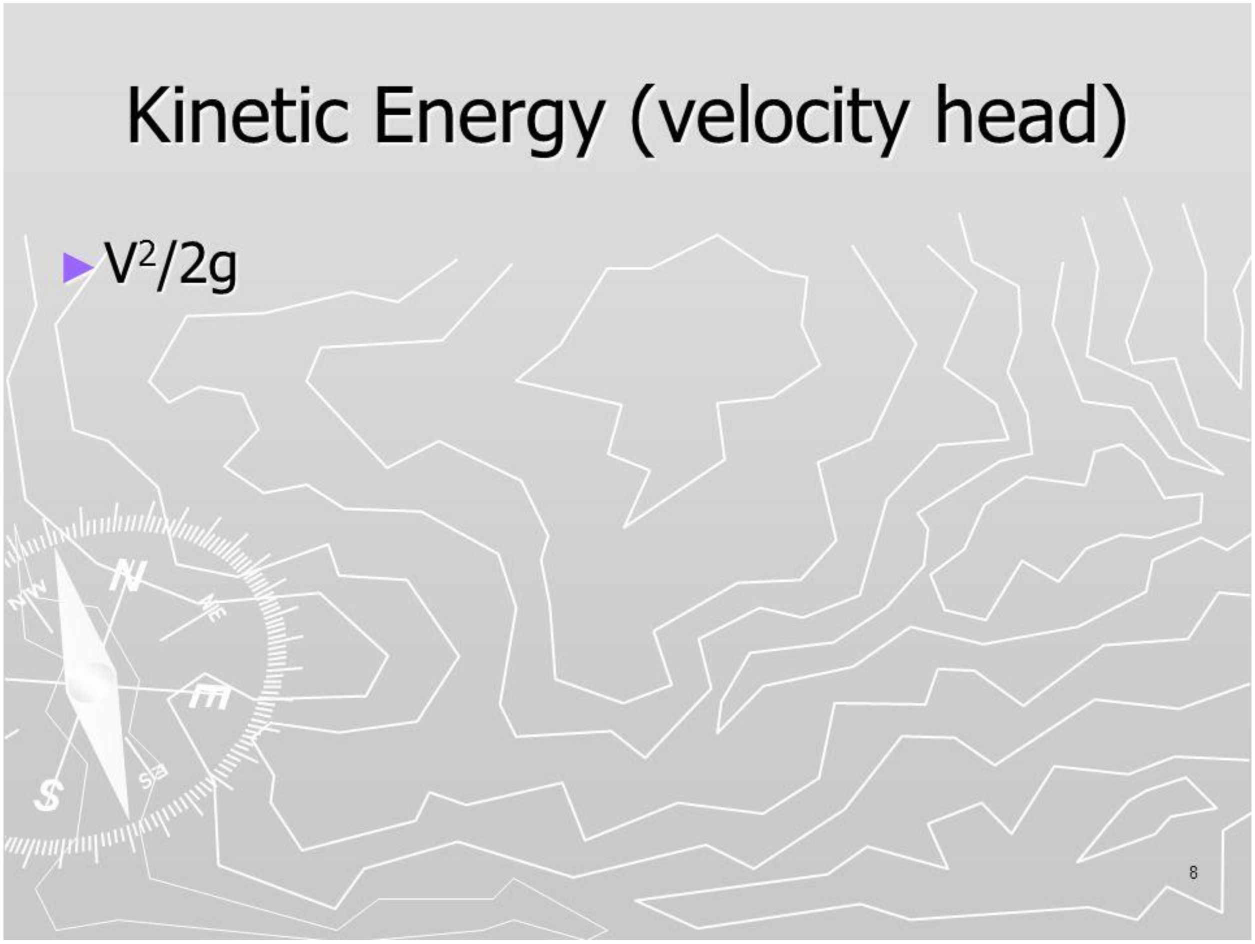
6. **Three Forms of Energy Kinetic energy (velocity) Potential energy (gravity)**
Pressure Energy (pump/tank)



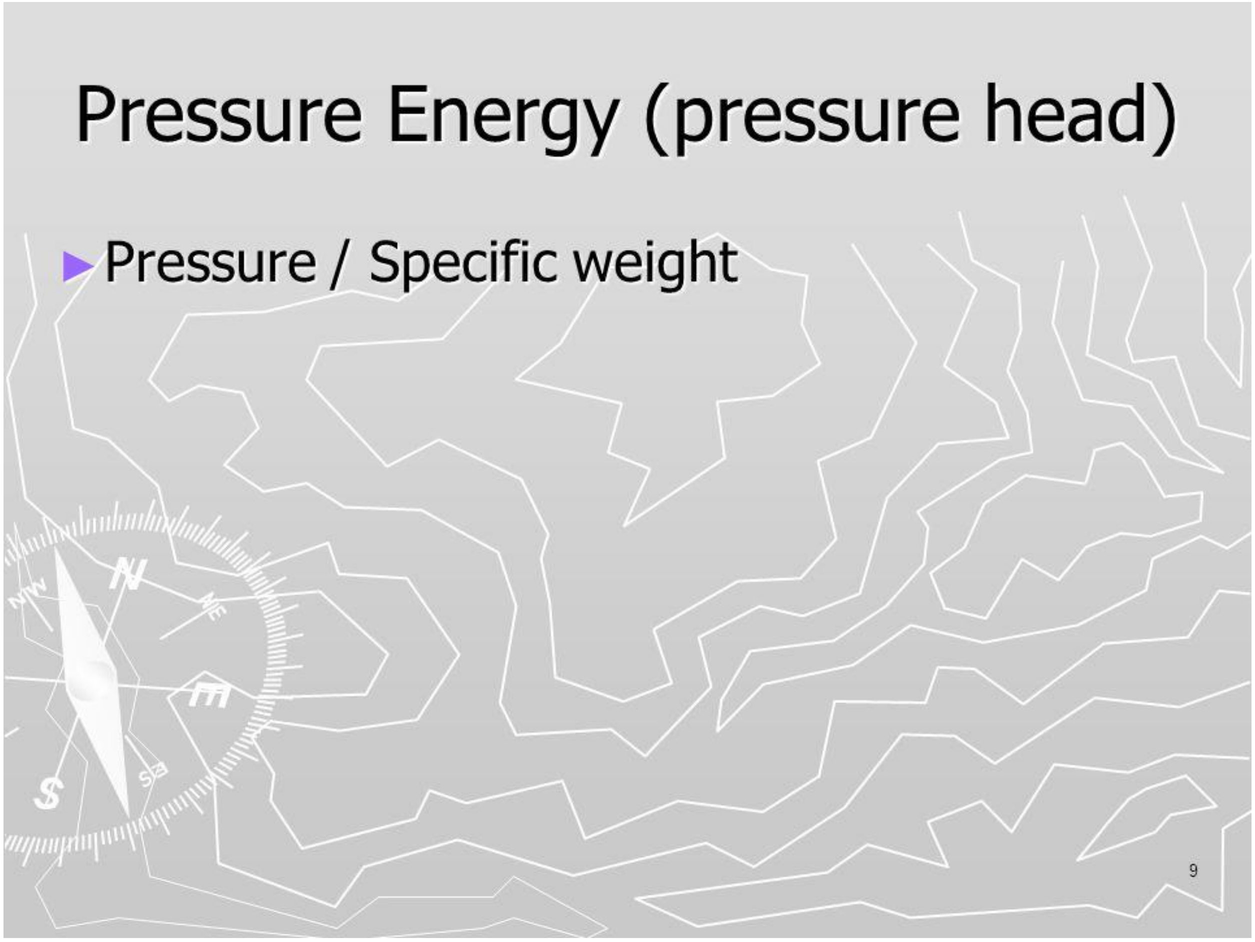
7. **Units Energy (ft or meters)**



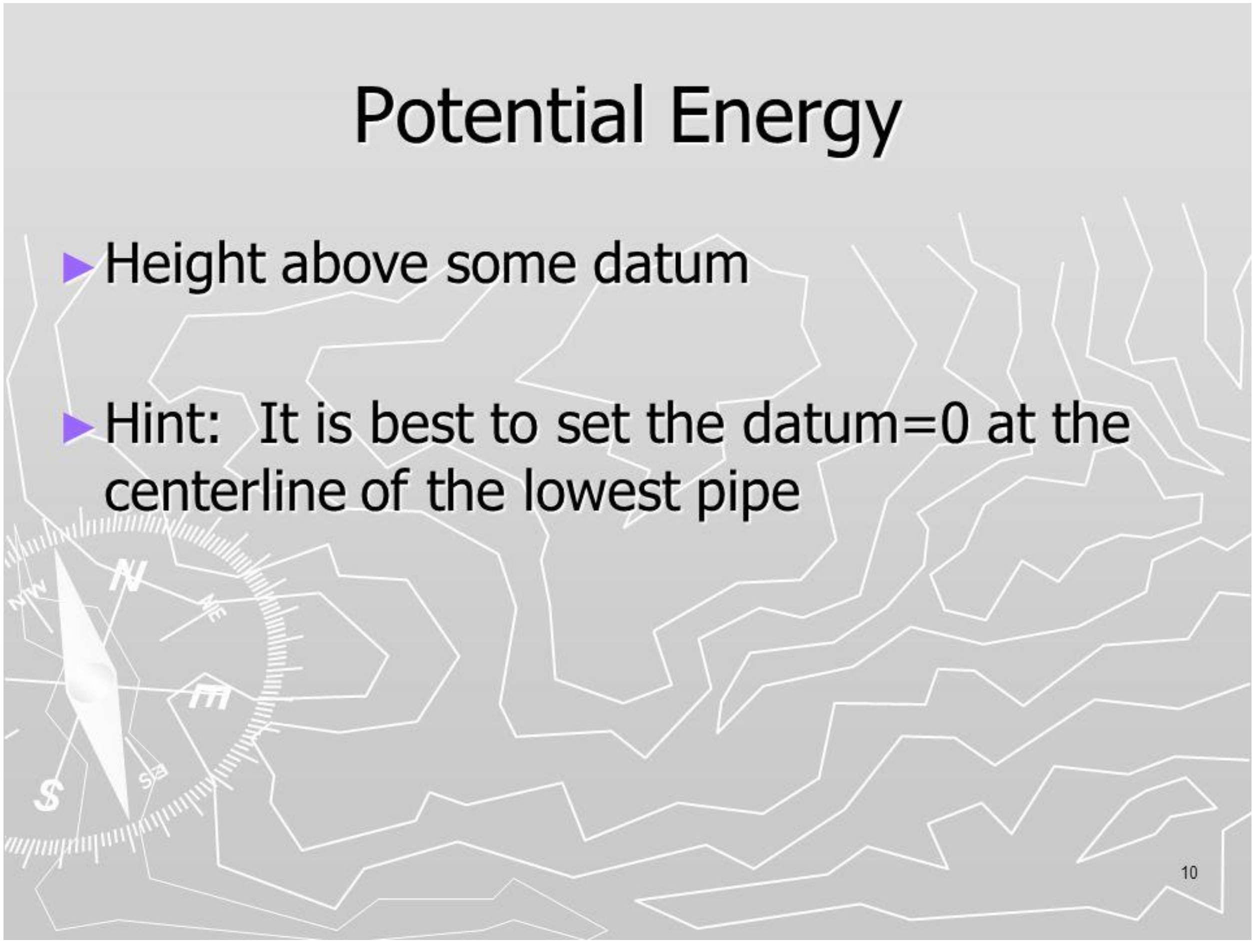
8. **Kinetic Energy (velocity head)**
V2/2g



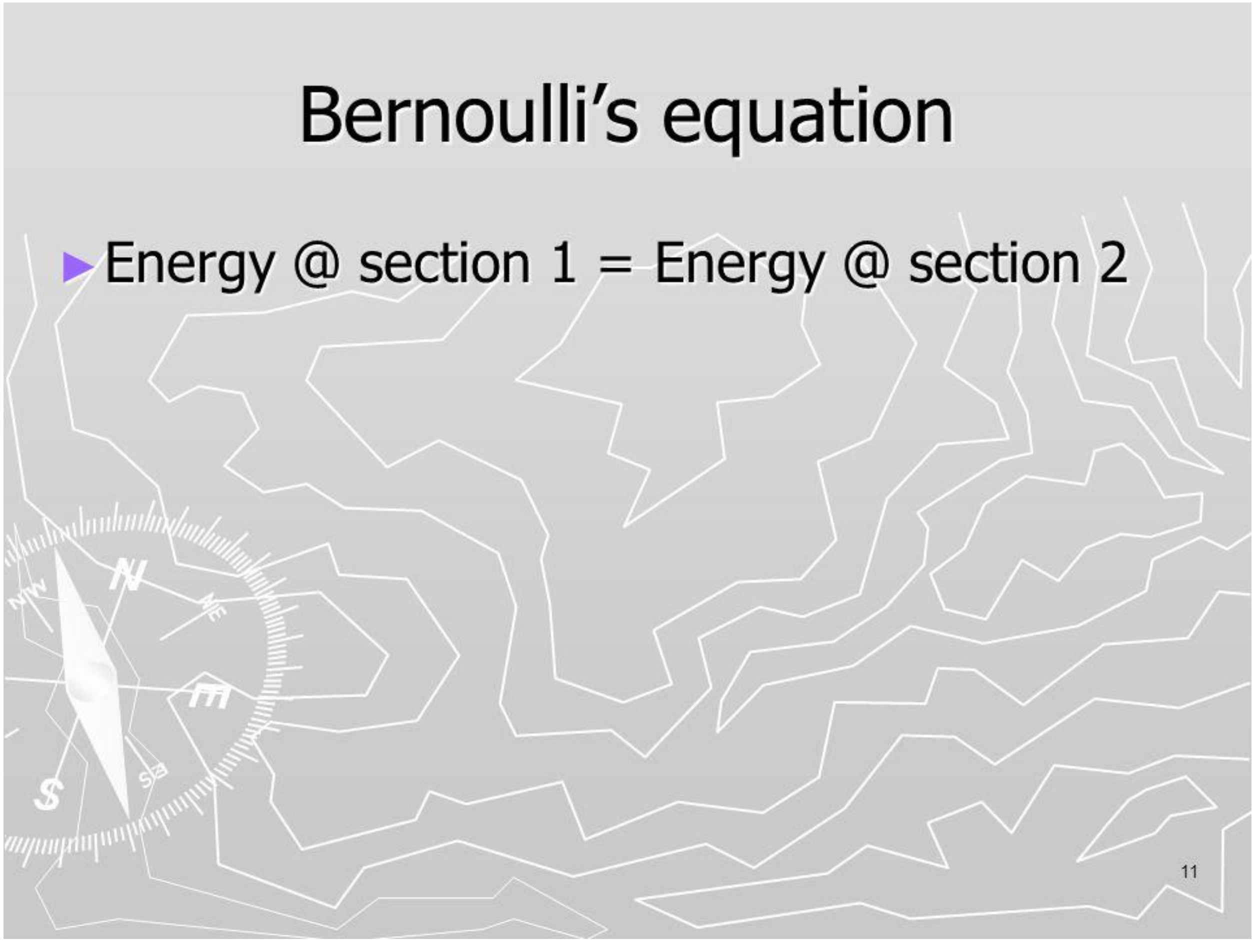
9. **Pressure Energy (pressure head)**
Pressure / Specific weight



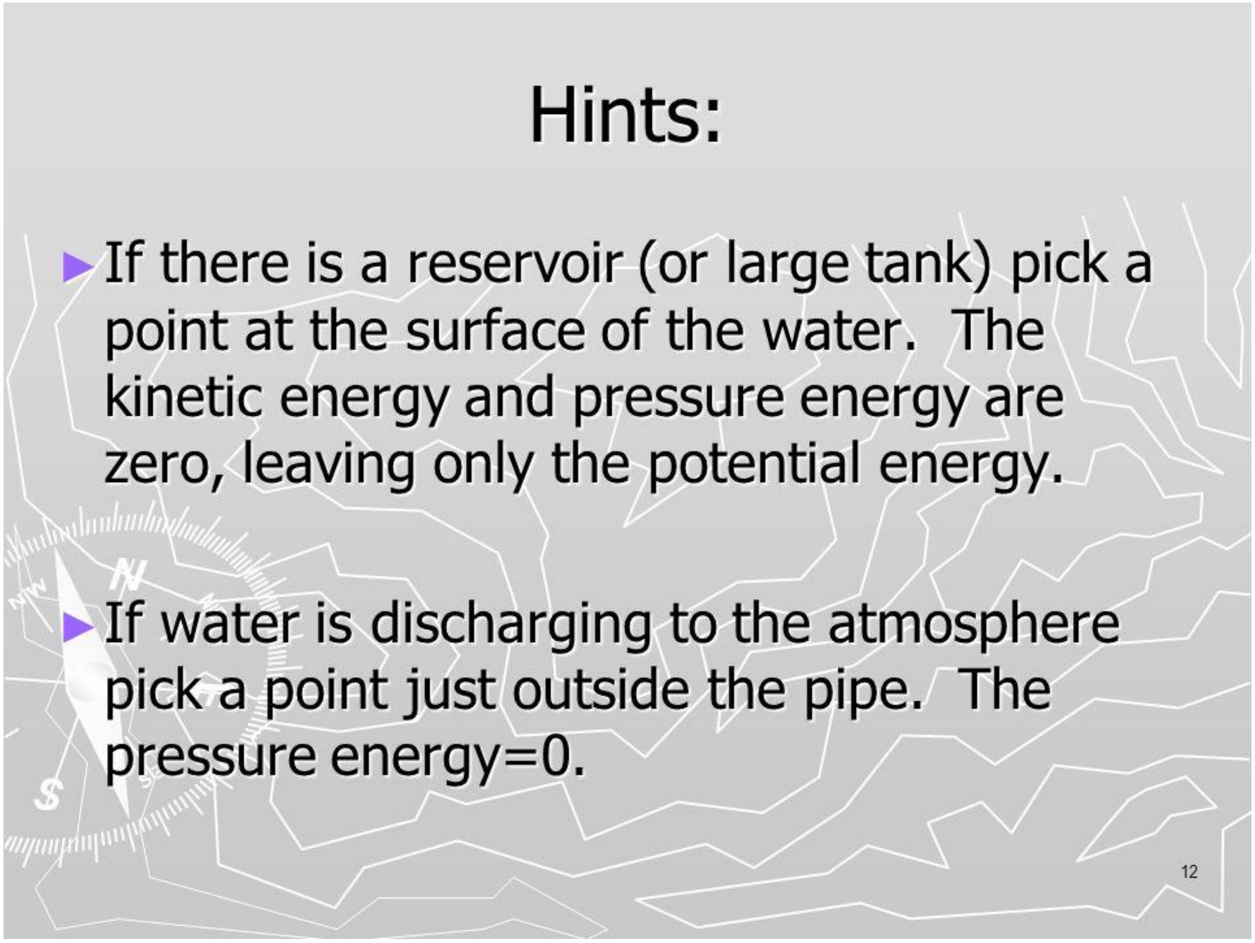
10. **Potential Energy Height above some datum**
Hint: It is best to set the datum=0 at the centerline of the lowest pipe



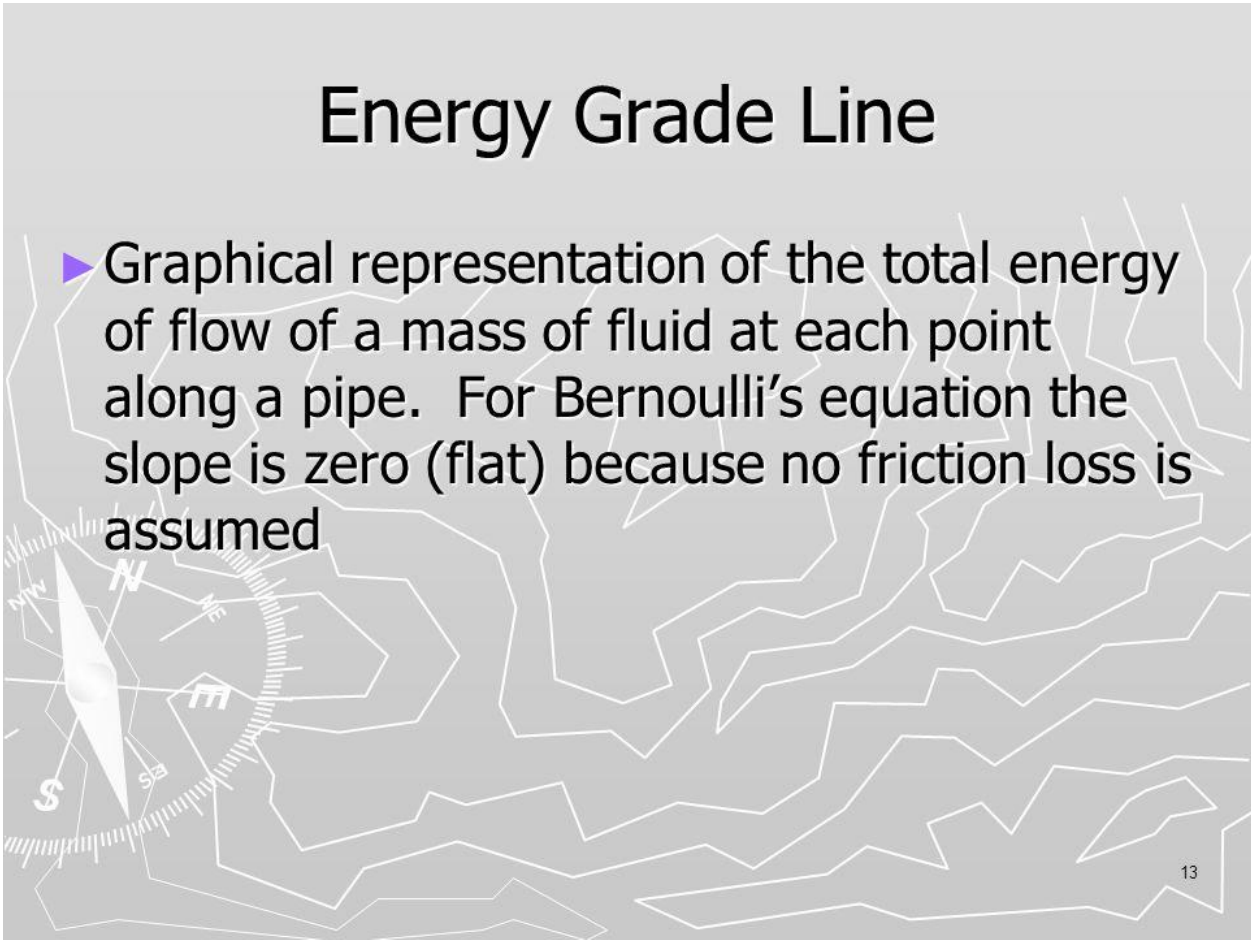
11. **Bernoulli's equation section 1 = section 2**



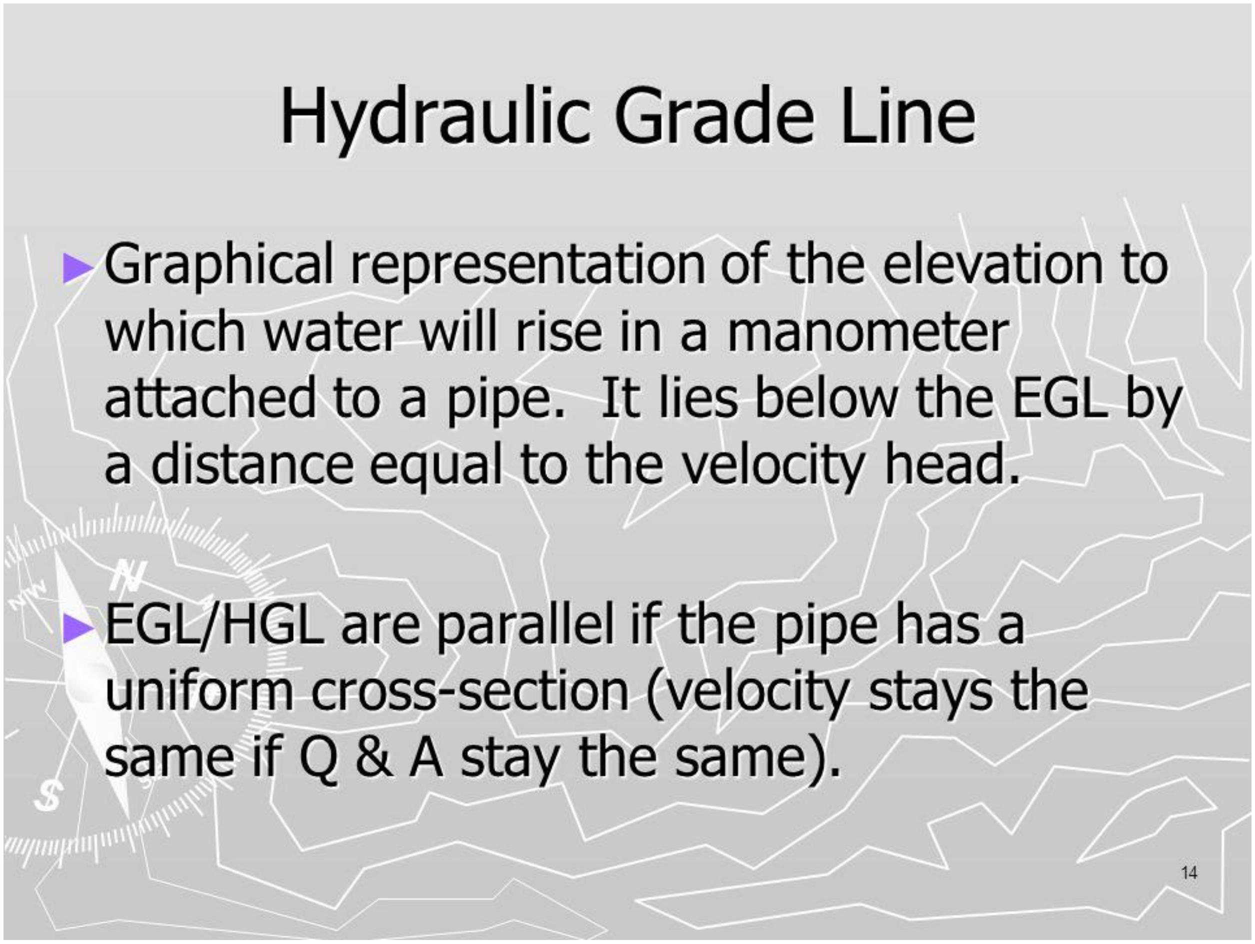
12. **Hints:** If there is a reservoir (or large tank) pick a point at the surface of the water. The kinetic energy and pressure energy are zero, leaving only the potential energy. If water is discharging to the atmosphere pick a point just outside the pipe. The pressure energy=0.



13. Energy Grade Line Graphical representation of the total energy of flow of a mass of fluid at each point along a pipe. For Bernoulli’s equation the slope is zero (flat) because no friction loss is assumed

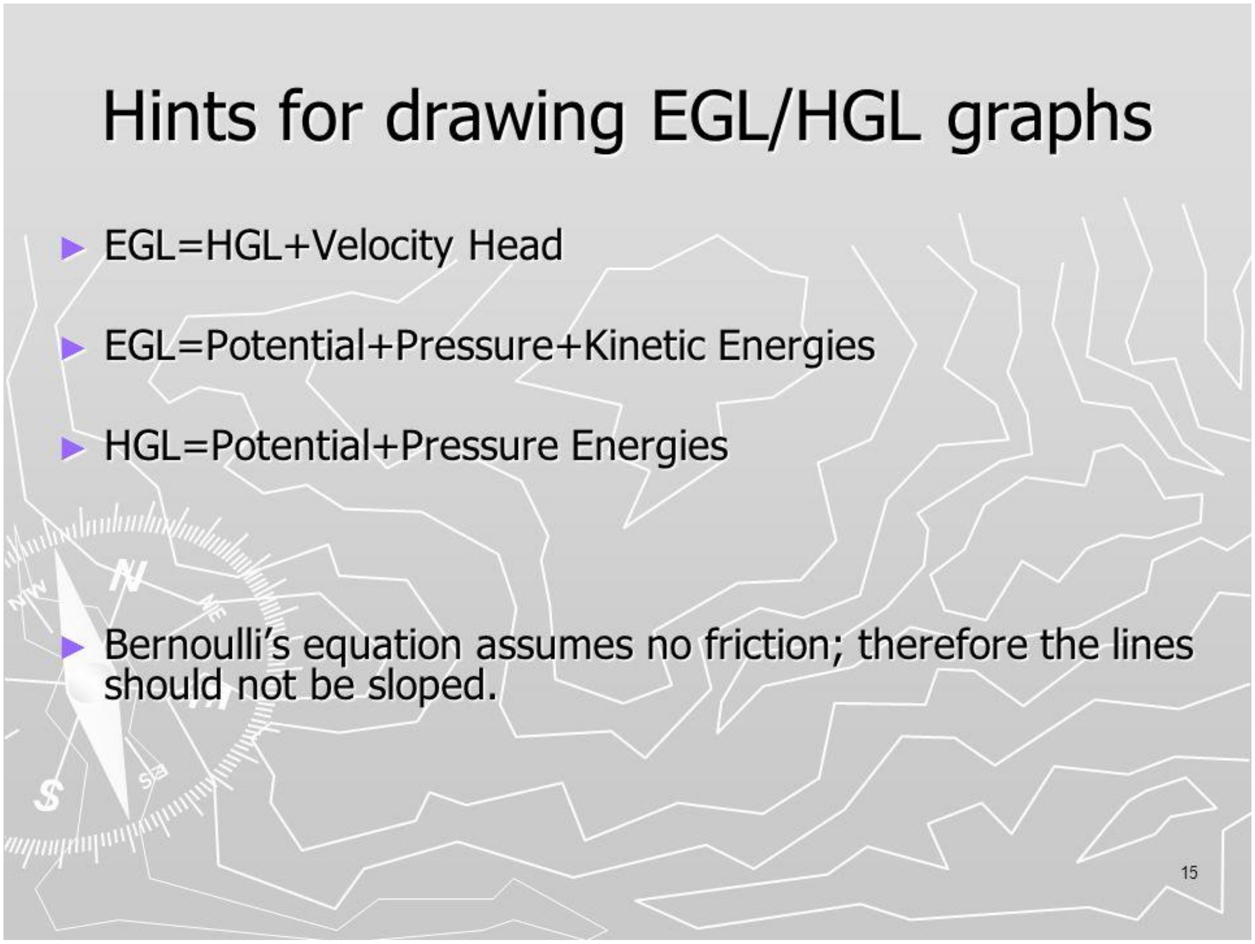


14. Hydraulic Grade Line Graphical representation of the elevation to which water will rise in a manometer attached to a pipe. It lies below the EGL by a distance equal to the velocity head. EGL/HGL are parallel if the pipe has a uniform cross-section (velocity stays the same if Q & A stay the same).

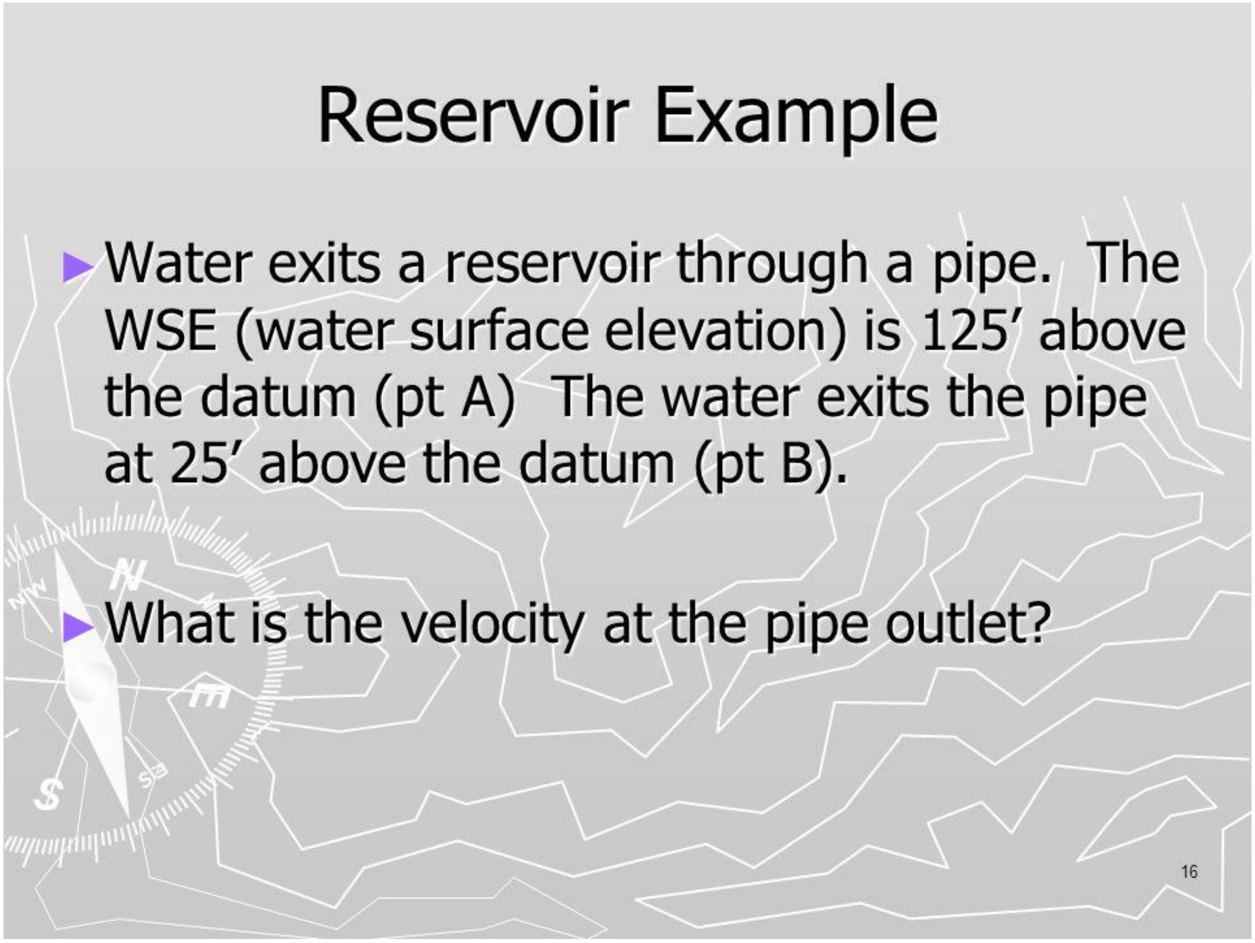


15. **Hints for drawing EGL/HGL graphs**

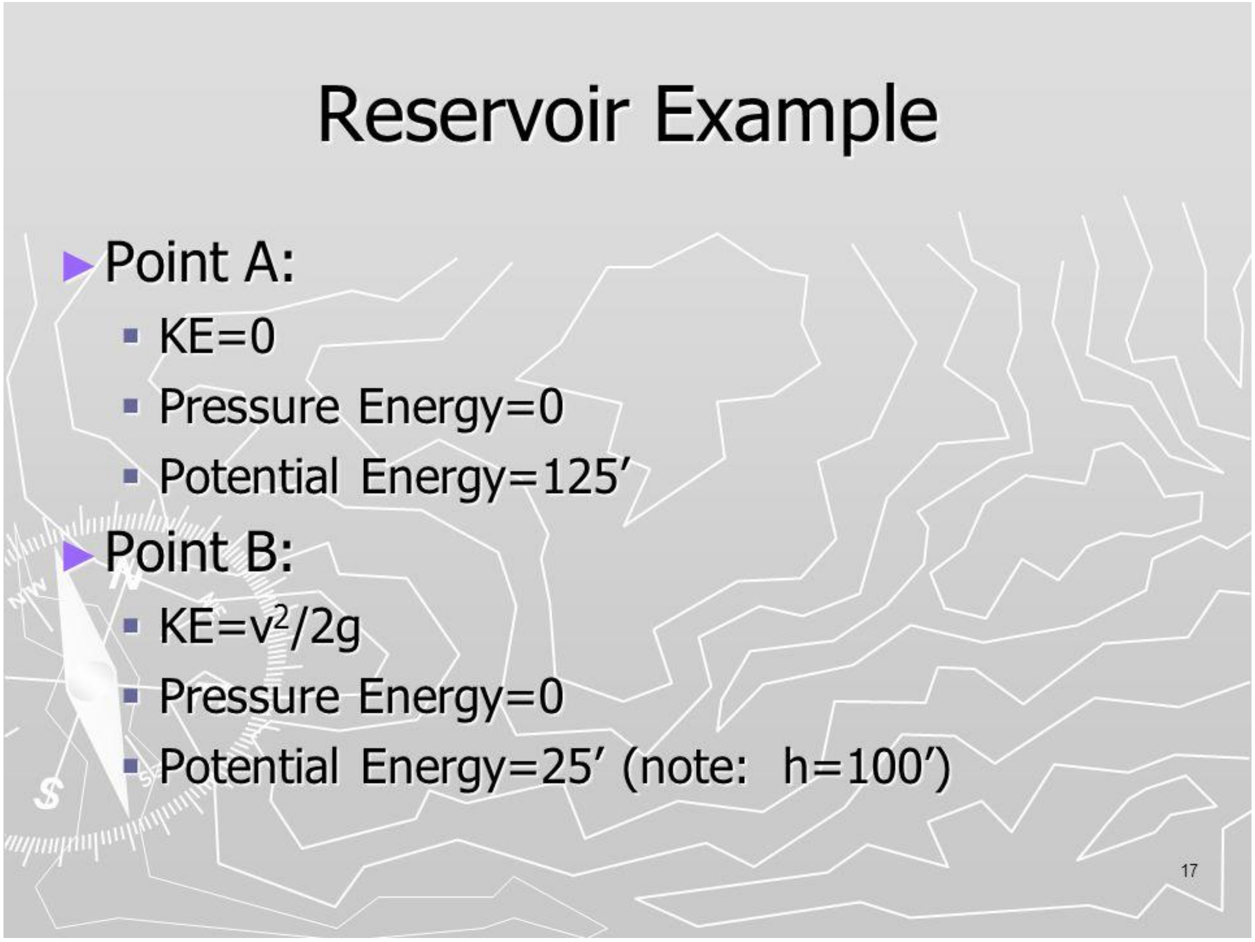
EGL=HGL + Velocity Head EGL = Potential + Pressure + Kinetic Energies HGL=Potential + Pressure Energies Bernoulli's equation assumes no friction; therefore the lines should not be sloped.



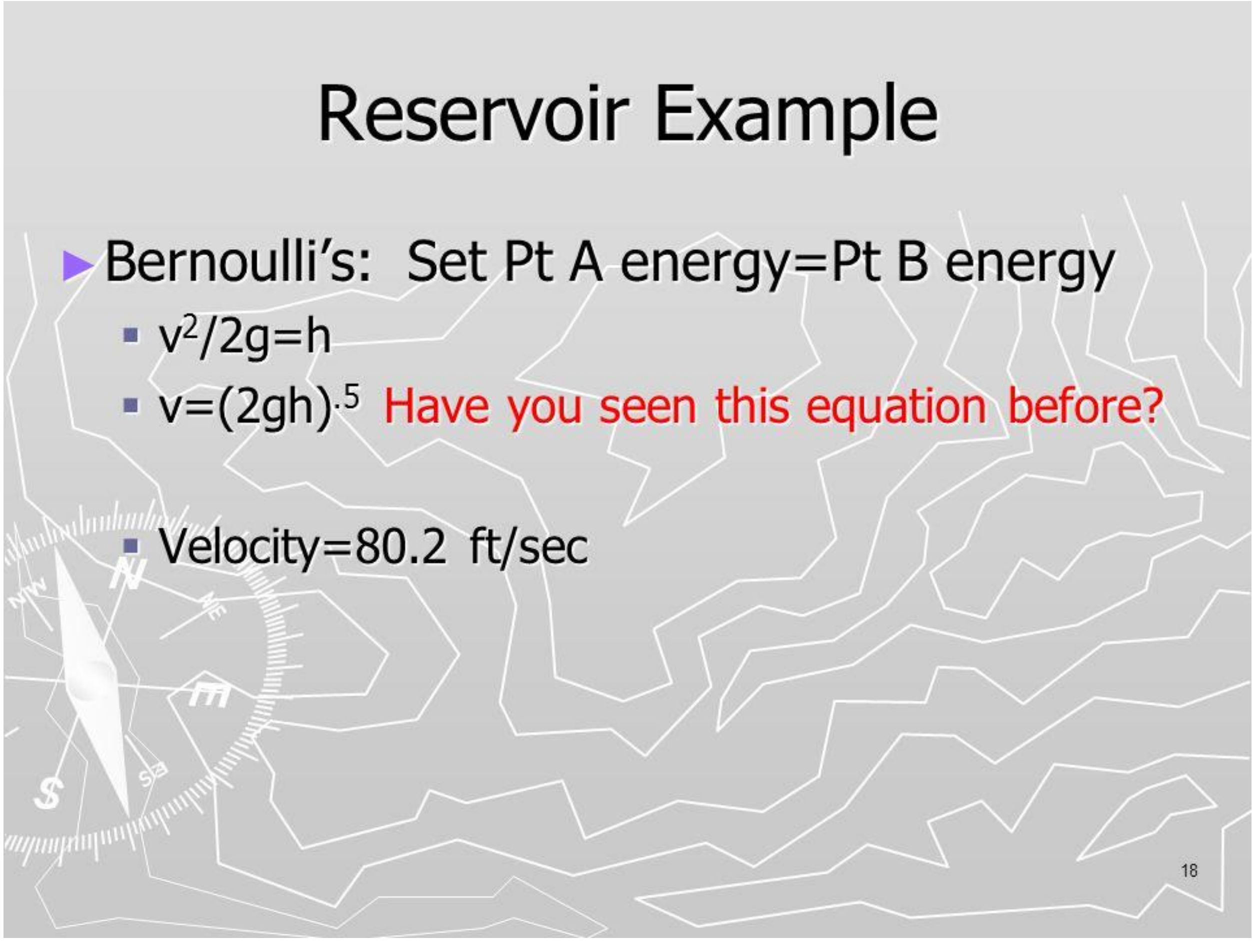
16. Reservoir Example Water exits a reservoir through a pipe. The WSE (water surface elevation) is 125' above the datum (pt A) The water exits the pipe at 25' above the datum (pt B).What is the velocity at the pipe outlet?



17. **Reservoir Example Point A: Point B: KE=0 Pressure Energy=0**
Potential Energy=125’Point B:KE=v2/2gPotential Energy=25’ (note: h=100’)

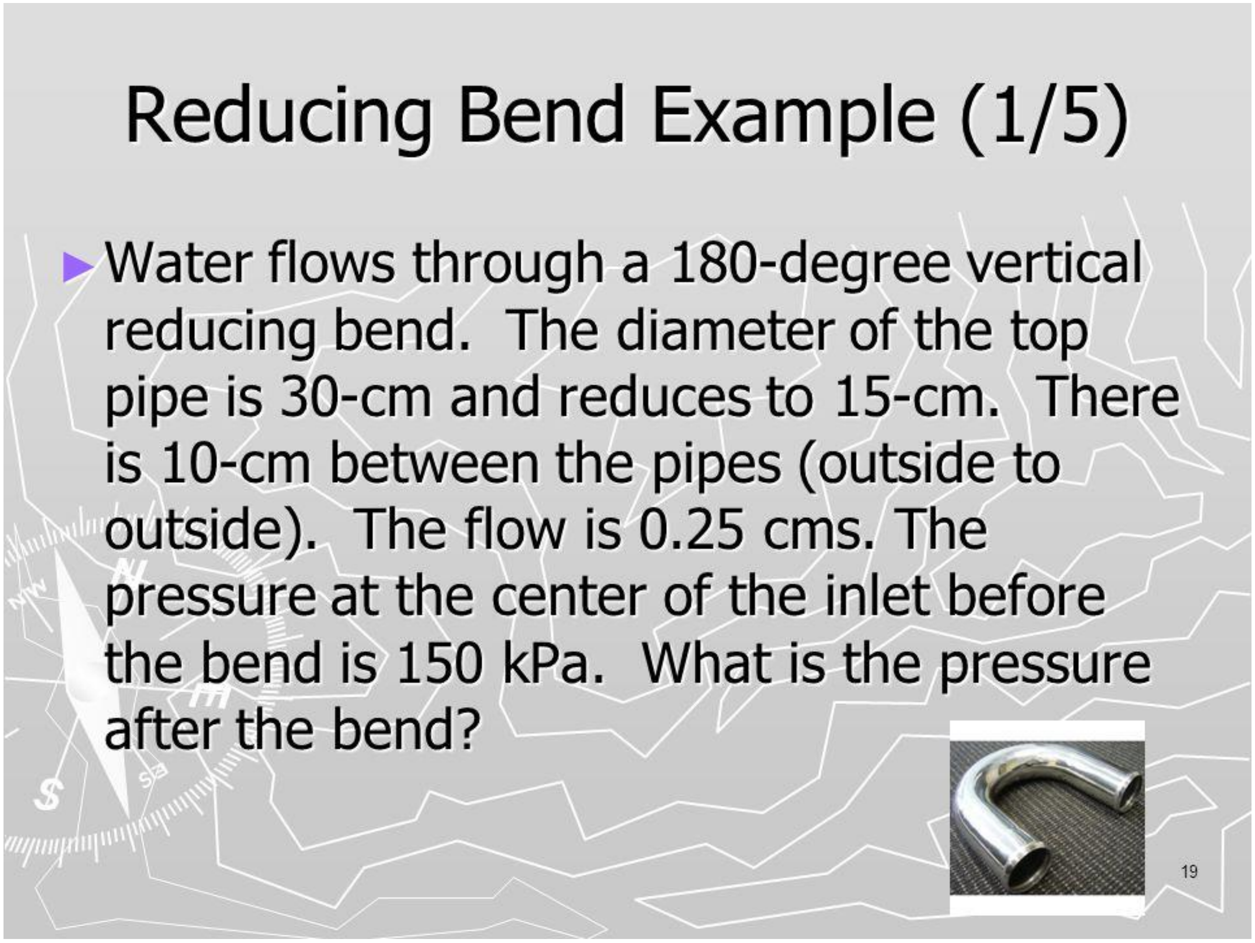


18. **Reservoir Example Bernoulli's: Set Pt A energy=Pt B energy v2/2g=h**
v=(2gh).5 Have you seen this equation before? Velocity=80.2 ft/sec



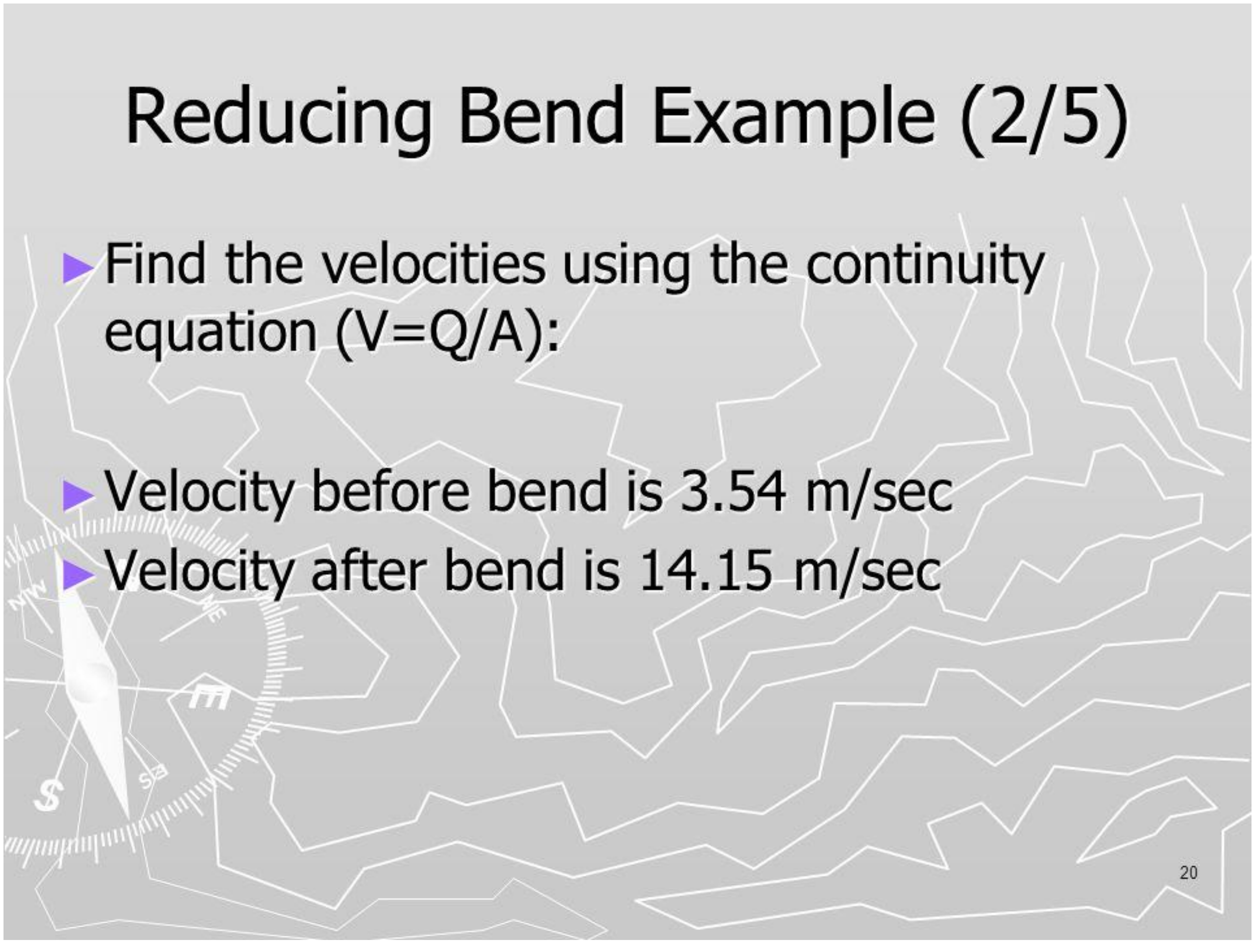
19. **Reducing Bend Example (1/5)**

Water flows through a 180-degree vertical reducing bend. The diameter of the top pipe is 30-cm and reduces to 15-cm. There is 10-cm between the pipes (outside to outside). The flow is 0.25 cms. The pressure at the center of the inlet before the bend is 150 kPa. What is the pressure after the bend?



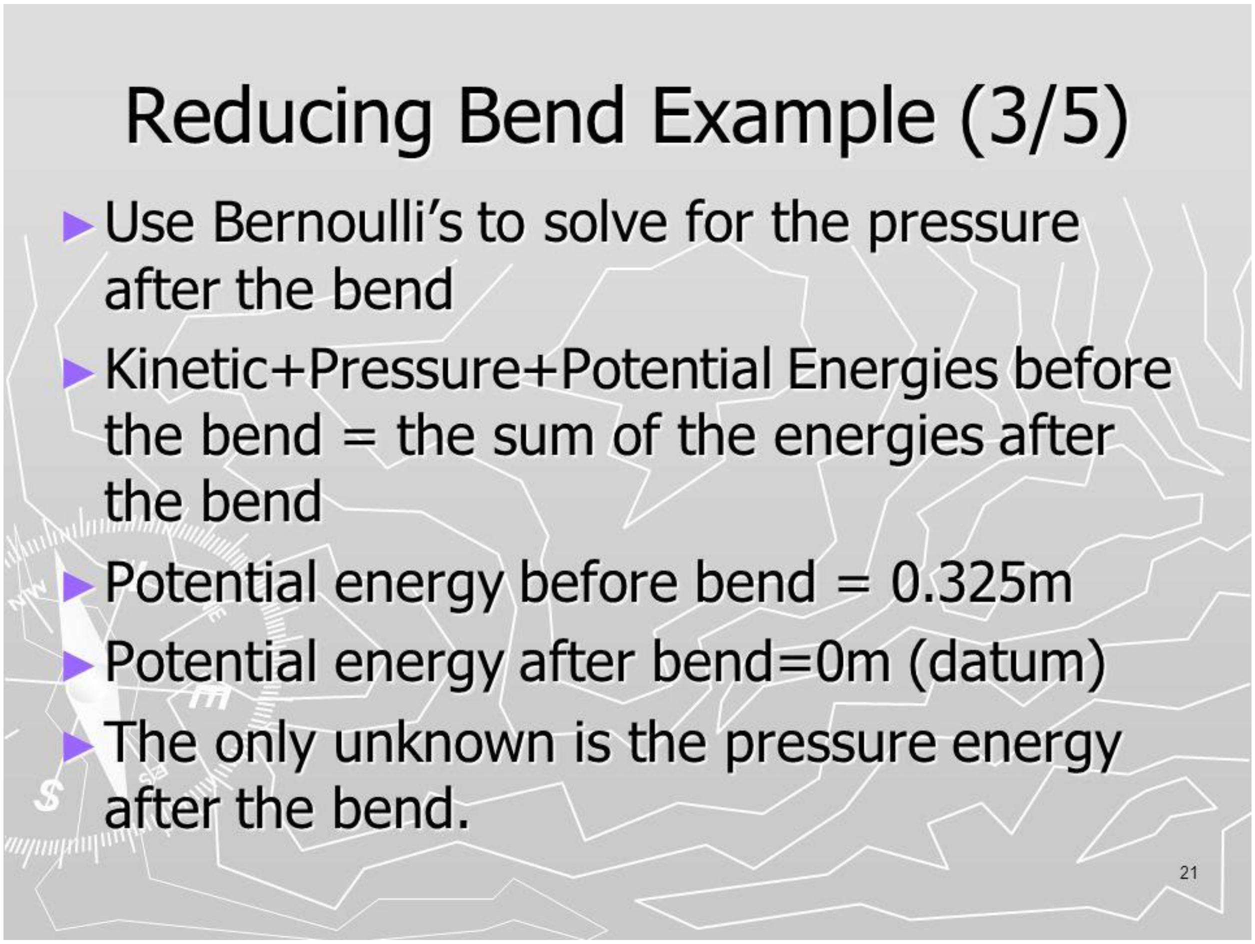
20. **Reducing Bend Example (2/5)**

Find the velocities using the continuity equation (V=Q/A):Velocity before bend is 3.54 m/sec Velocity after bend is m/sec

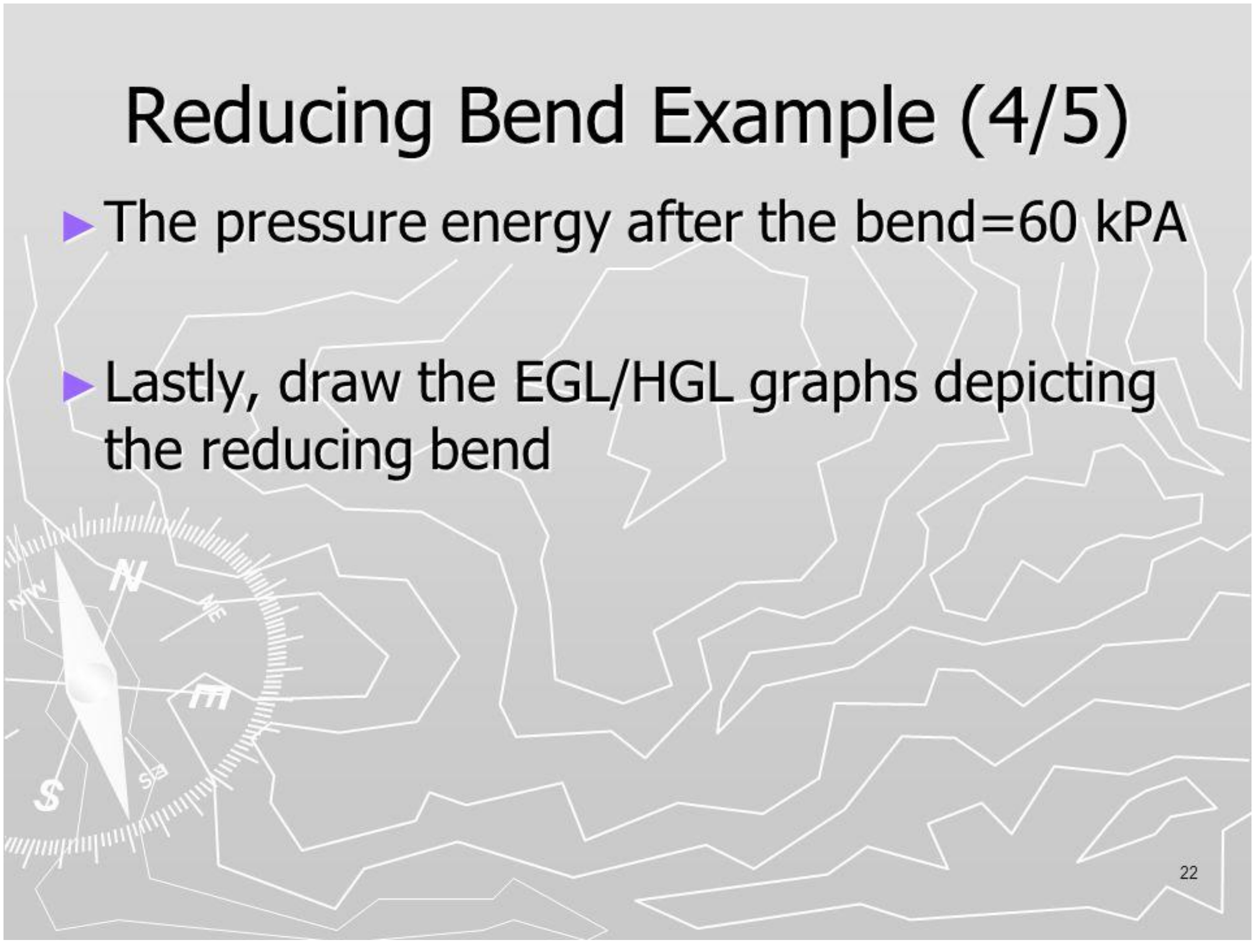


21. **Reducing Bend Example (3/5)**

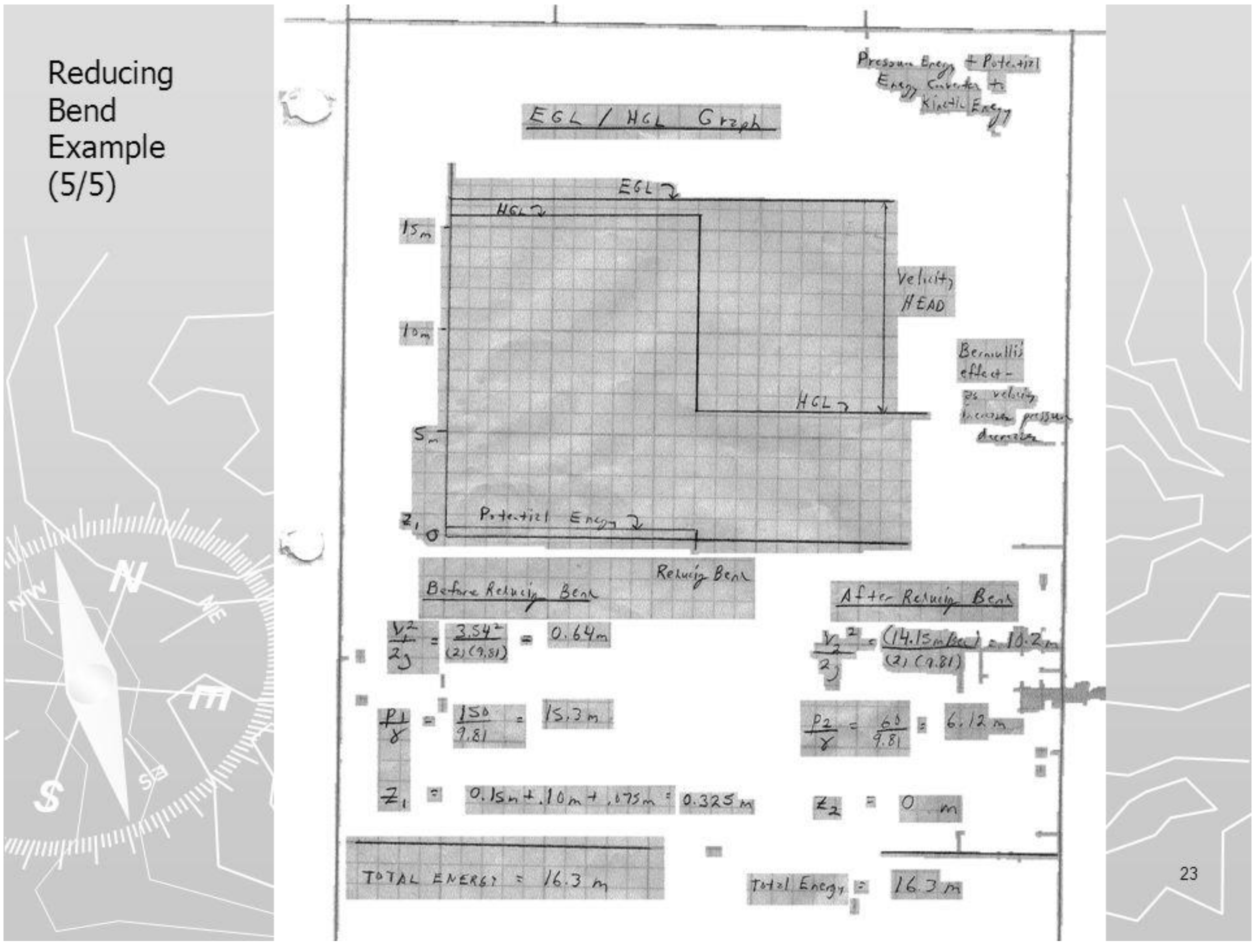
Use Bernoulli's to solve for the pressure after the bend Kinetic + Pressure + Potential Energies before the bend = the sum of the energies after the bend Potential energy before bend = 0.325mPotential energy after bend=0m (datum)The only unknown is the pressure energy after the bend.



22. **Reducing Bend Example (4/5)**
The pressure energy after the bend=60 kPA Lastly, draw the EGL/HGL graphs depicting the reducing bend



23. **Reducing Bend Example (5/5)**



24. **Next Lecture Energy equation**
Accounts for friction loss, pumps and turbines